

Benchmarking Energy Use in California Commercial Buildings

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2002 ACEEE Summer Study

August 19, 2002



Overview

- ▣ Project Background
- ▣ Benchmarking
 - ▣ Benchmarking approach
 - ▣ Regional Benchmarking for California
- ▣ Development of Cal-Arch
 - ▣ Data – sources, requirements
- ▣ Future development and directions



Benchmarking

- ❑ Building Energy Benchmarking refers to the comparison of building energy use, typically energy use intensity (EUI), of one building vs. a target population
 - ❑ EUI = energy use per square foot
- ❑ Provides a useful starting point in an energy audit to evaluate energy savings potential



Cal-Arch Project

- Part of 3-year PIER project (High Performance Commercial Building Systems)
 - *Year 1*: Analyze CEUS data and write specification for California tool
 - *Year 2*: Initial software using CEUS data, additional analysis, technical memoranda
 - *Year 3*: Final software version, 2 workshops, final report (began Aug 2002)



Cal-Arch

California Building Energy Reference Tool - Netscape

File Edit View Go Communicator Help

Back Forward Reload Home Search Guide Print Security Stop Netscape

Bookmarks Location http://poet.lbl.gov/testarch/compare.html

CALARCH

CALIFORNIA BUILDING ENERGY REFERENCE TOOL

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[Back](#) - [Getting Started](#) - [Compare](#) - [Interpret Results](#)

- 1 Select the **principal activity** of your building:
- 2 Enter the building's **floor area**, (gross square feet)
If both **floor area** and energy use are entered, an EUI will be calculated for your building and displayed on the graph.
☐ Check here to display only buildings with comparable floor area.
- 3 Enter the **annual energy consumption** for your building for each fuel used:

Fuel	Energy Consumption
Electricity	<input type="text" value="0"/> kWh/year
Natural Gas	<input type="text" value="0"/> therms/year
Other	<input type="text" value="0"/> Million Btu/year

☐ Check here if the data entered represents whole building energy use.
- 4 Enter the **zipcode** your building is located in.
If a zip code is entered, only buildings within the same **climate zone** will be displayed. Use this field only if your building is within PG&E or SCE service territory.
- 5 Select how **energy use** should be reported: ☒ Site ☐ Source
- 6 ☐ Check here if you are entering real data and think they would be useful to **add to our database**

Document: Done

- ❑ Simple online benchmarking tool
- ❑ Provide California-specific information
- ❑ Only public interface to small slice of CEUS

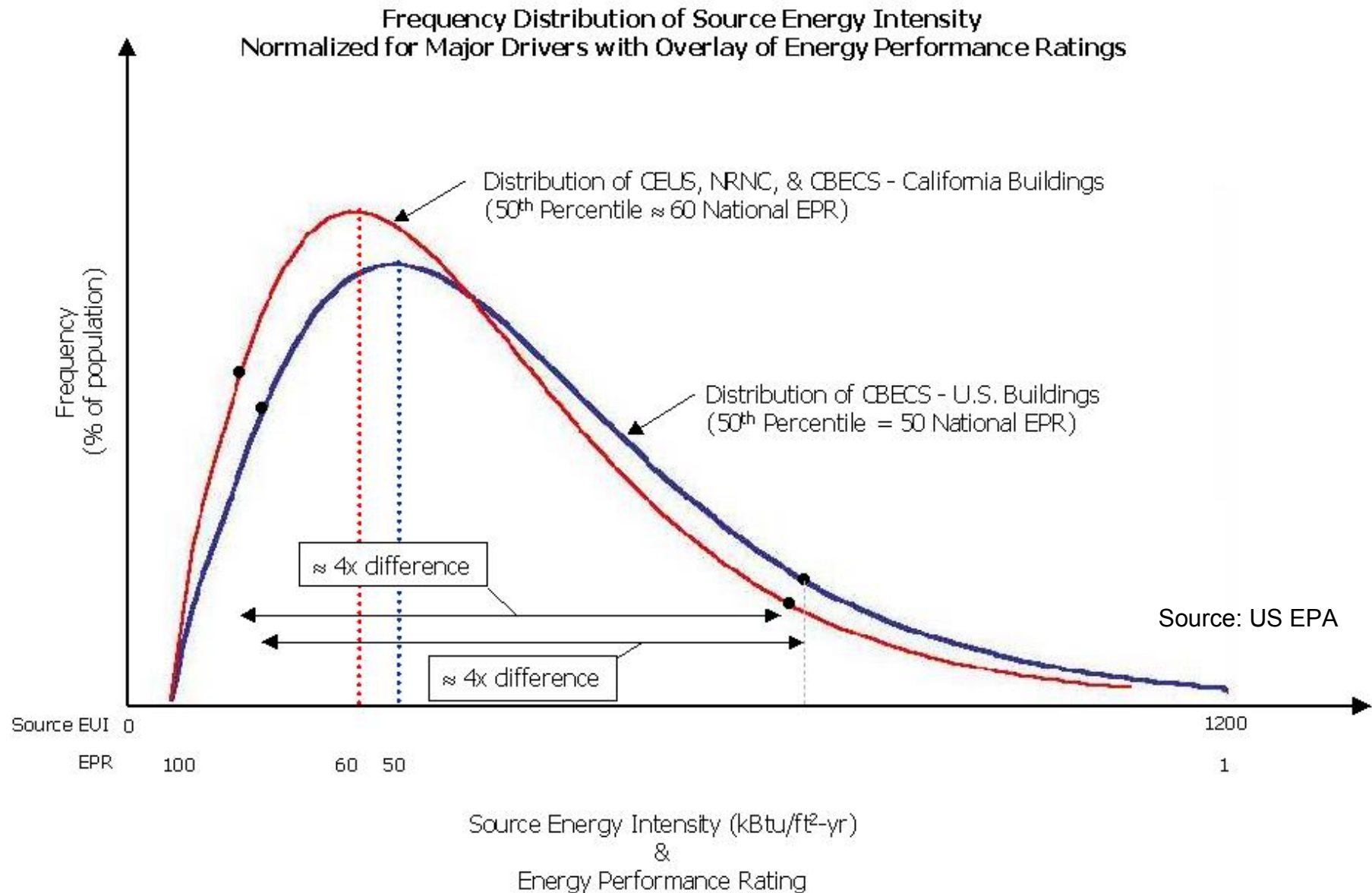


Activities with EPA/CEC

- ❑ *Do California buildings use less energy?*
- ❑ Policy concern is that buildings with significant savings potential will be labeled as 'efficient'
- ❑ One proposal is to require CA buildings to achieve higher Energy Performance Rating (81 or 85 vs. 75) to receive Energy Star Label until new ratings model is released



Do CA buildings use less energy?

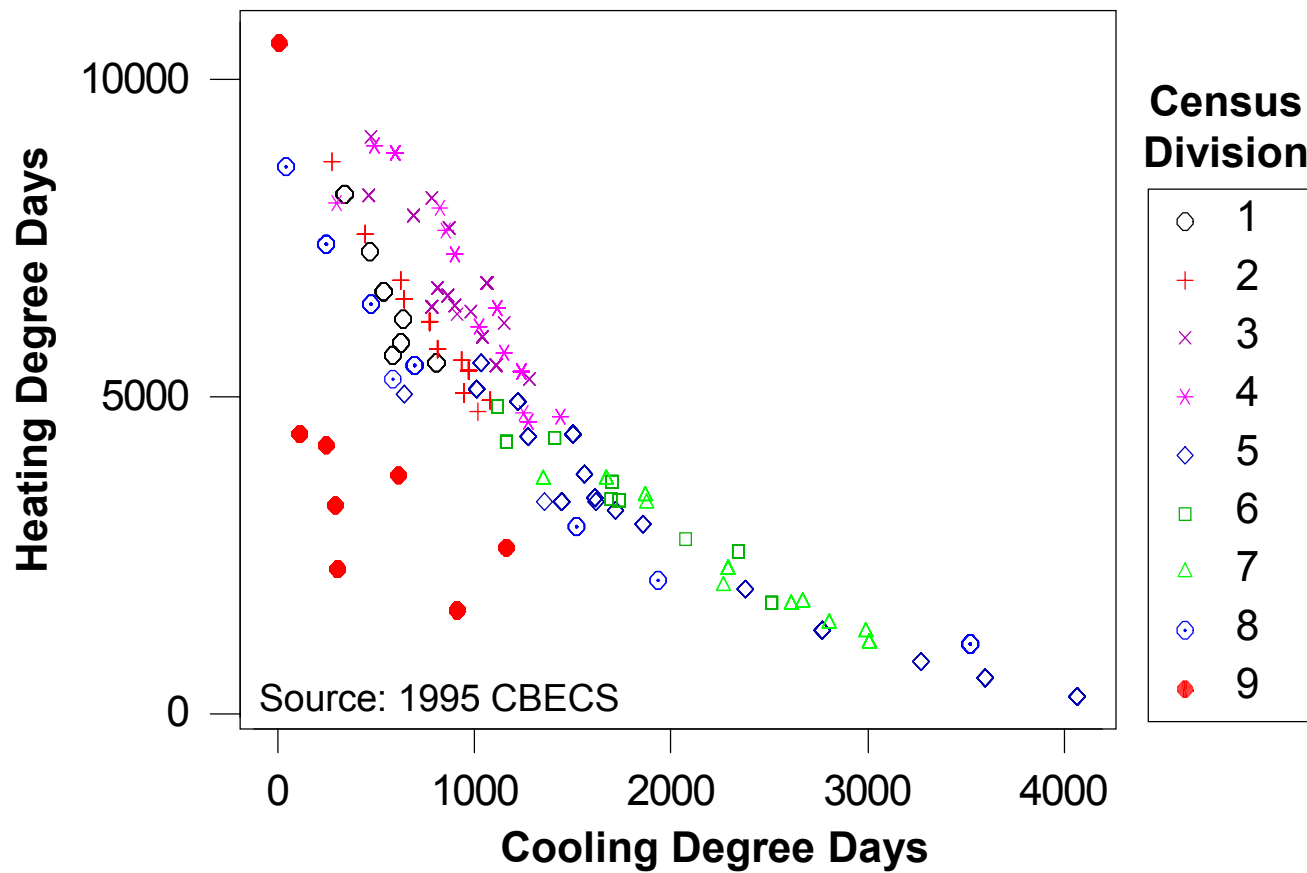


Possible explanations

- ❑ Climate
- ❑ Strict building codes, conservation incentives
- ❑ Higher prices = more conservation?
 - ❑ Conservation and efficiency measures become more cost-effective



HDD & CDD by Census Division



What about other tools?

- ❑ Numerous efforts nationally and internationally to benchmark energy use
 - ❑ eg. Energy Star
 - ❑ See poet.lbl.gov/cal-arch/links/
- ❑ Most existing national tools based on CBECS
 - ❑ Finest geographic resolution is Census Division
- ❑ Opportunity to utilize rich data on California buildings contained in CEUS



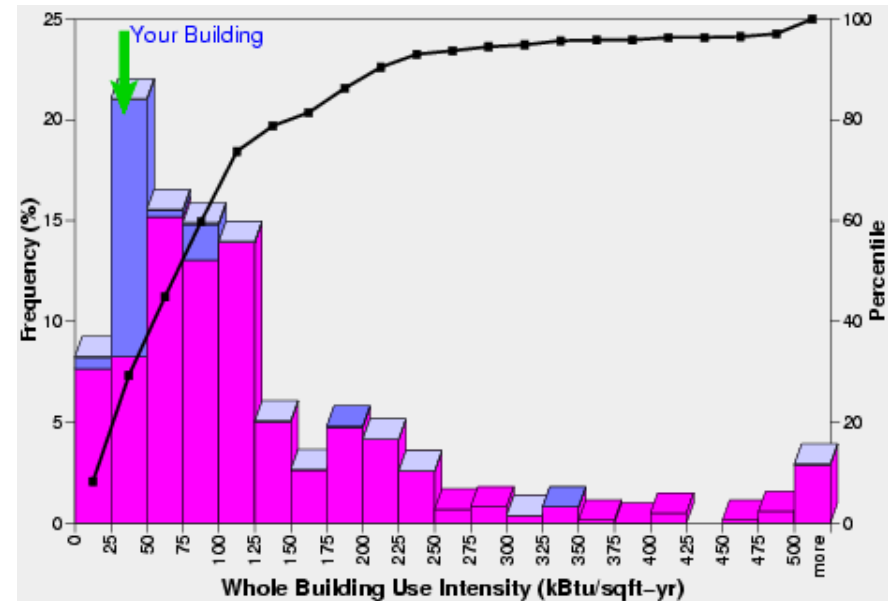
Types of Benchmarking

- ❑ Points-Based (LEED)
- ❑ Simulated Models (DOE-2)
- ❑ Statistical Analysis-Regression (Energy Star)
- ❑ Statistical Analysis-Distributional
 - ❑ Percentile rankings, histograms
 - ❑ Robust against outliers (EUI distributions are generally non-normal)



Cal-Arch Approach

- EUIs represent actual energy use in actual buildings
 - No adjustments or correction factors
- Distributional comparisons
 - Whole building, gas, electricity



California Commercial End Use Survey (CEUS)

- ❑ 1992-96 surveys covering major utility service territories
 - ❑ Using approx 2000 locations in PG&E & SCE areas
- ❑ Population-based survey
- ❑ Extremely detailed
 - ❑ Mechanical Systems (heating, cooling, dhw)
 - ❑ Structural characteristics
 - ❑ End use characteristics (lighting, process, misc)



Other Data Sources

- ❑ Non-Residential New Construction Survey
- ❑ Individual buildings, smaller datasets
 - ❑ Energy Star buildings
 - ❑ US GSA
- ❑ CBECS (DOE Commercial Building Energy Consumption Survey)
 - ❑ EPA has extracted CA buildings with reasonable confidence by filtering Division 9 buildings by HDD and CDD



Cal-Arch Inputs

- 1** Select the **principal activity** of your building:

Office/Professional

- 2** Enter the building's **floor area**. (gross square feet)
If both **floor area** and energy use are entered, an **EUI** will be calculated for your building and displayed on the graph.

☐ Check here to display only buildings with comparable floor area.

- 3** Enter the **annual energy consumption** for your building for each fuel used:

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Building Type

- ❑ Required Cal-Arch user input
- ❑ Cal-Arch maps CEUS building types (principal building activity) to correspond with CBECS categories
 - ❑ Familiarity
 - ❑ Consistency
 - ❑ Sample size



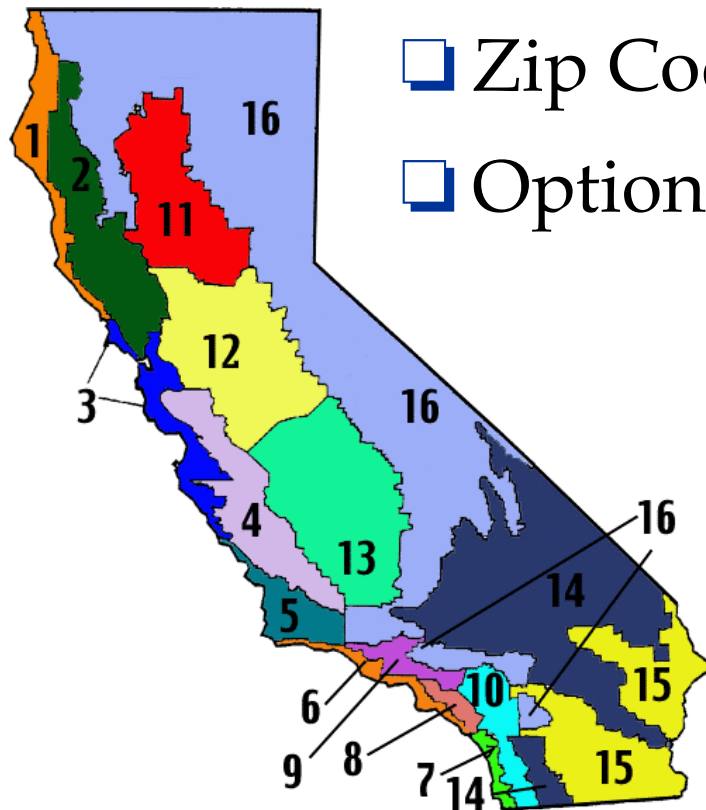
Floor Area

- ❑ Cal-Arch user input for calculating user EUI and as optional filtering variable
 - ❑ Returns locations with $\frac{1}{2}$ to 2 times the user's floor area
- ❑ Greatest source of uncertainty in EUI distributions
 - ❑ Varying definitions, measurement methods



Location

- ❑ Minimum desired geographic resolution is California climate zone
- ❑ Zip Code available in CEUS
- ❑ Optional user input on Cal-Arch



- ❑ Returns buildings within same climate zone
- ❑ Reduces sample size – can group zones to increase sample size

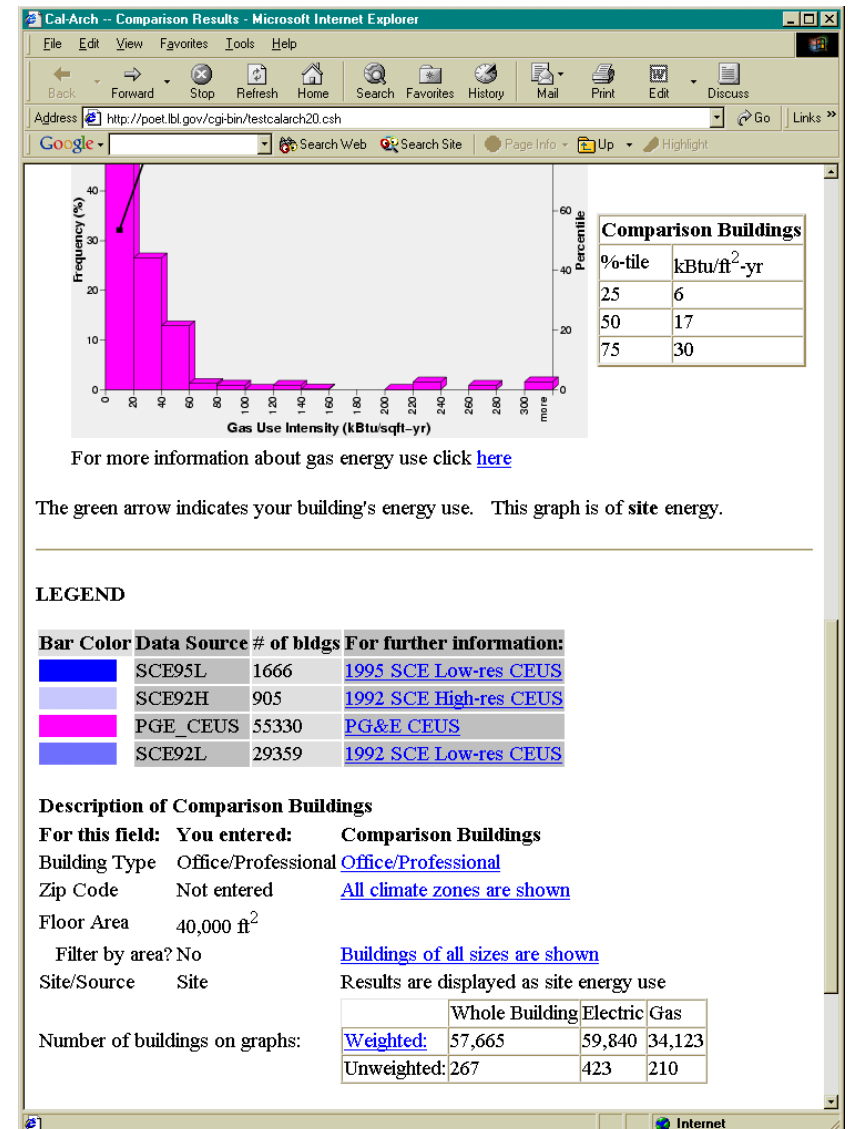
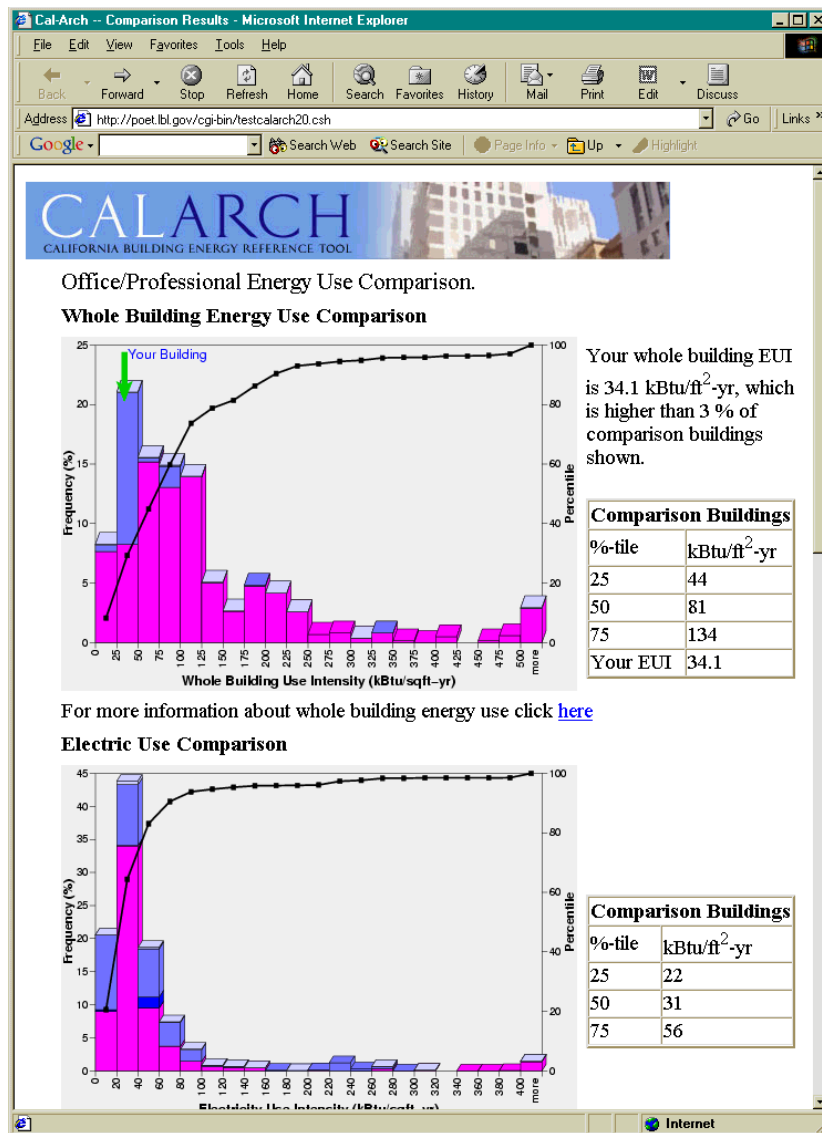


Energy Use

- ❑ CEUS energy data provided by utilities
 - ❑ Data are accurate, but not complete – reported energy does not represent whole building energy if fuels provided by different utilities
- ❑ Information on *which* fuels used and for what end use is provided – just not how much
 - ❑ This was used to determine whether whole-building energy use was reported



Current Cal-Arch Output



Future Directions

- ❑ Incorporate additional building information
 - ❑ Heating/Cooling
 - ❑ Vintage
- ❑ Peak Demand benchmarking
- ❑ DOE-2 Models calibrated against building stock
 - ❑ Analyze potential savings measures
 - ❑ Perform end-use breakdowns



Last Slide

- ❑ Web Site: <http://poet.lbl.gov/cal-arch>
 - ❑ Additional tools <http://poet.lbl.gov/cal-arch/links/>
- ❑ Contact: SKinney@lbl.gov, (510) 495-2365
- ❑ For related discussion
 - ❑ Tues 2 pm, Informal Session – “Tools for rating energy performance”
- ❑ Funding provided by CA Public Interest Energy Research (PIER) program

